Summary of previous episode

- Lambda to create procedures
- Mantra: The value returned by lambda is a procedure
- Difference between creation (lambda) and naming (define)
  - Beware of dirty sugar
- Means of abstraction
  - Lambda captures patterns
  - Define names it

Scheme rules

Evaluation:
- Self evaluating → return value
- name → return corresponding value
- Special → special
- Combination → evaluate subexpressions
  - apply procedure to operands
- Lambda → create a procedure

Application:
- Primitive procedure → just do it
- Compound procedure → evaluate body
  - with each parameter replaced by arguments

What do the following expressions evaluate to?

\[(\text{lambda} \ (x) \ (* \ x \ x))\]
\[(\text{lambda} \ (x) \ (* \ x \ x)) \ 5\]
\[(\text{define} \ \text{double} \ (\text{lambda} \ (x) \ (* \ 2 \ x)))\]
\[(\text{double} \ (\text{double} \ 6))\]
\[(\text{double} \ \text{double})\]
\[(\text{average} \ 4 \ (\text{double} \ 4))\]

What do the following expressions evaluate to?

\[(\text{define} \ \text{cube} \ (\text{lambda} \ (x) \ (* \ x \ x)))\]
\[(\text{cube} \ 3)\]
\[(\text{define} \ + 3)\]
\[(\text{define} \ - 6)\]
\[(+ \ -)\]

Computing pi

\[u_n: \text{edge length of n-gon}\]
\[u_{2n} = \sqrt{\frac{1}{2} \left(1 - \sqrt{1 - u_n^2}\right)}\]
And \[u_n = \frac{1}{2}\]
(because \[u_n = \sin \frac{\pi}{n}\])
We have \[\pi \approx n \cdot u_n\]
Write a function \([u_2n \ un]\)

Call me sugar

\[(\text{define} \ (x) \ (+ \ x \ 2))\]

Always remember to desugar
Lambda and variables

\(\text{\texttt{(define f (lambda (x) (+ x 1)))}}\)
\(\text{\texttt{(define g (lambda (x) (+ x 3)))}}\)
\(\text{\texttt{(define x 8)}}\)
\(\text{\texttt{(f 4)}}\)
\(\text{\texttt{(g 5)}}\)
\(\text{\texttt{x}}\)

Type and errors

\(\text{\texttt{(define square (lambda (x) (* x x)))}}\)
\(\text{\texttt{(square +)}}\)

Where is the error, who is complaining?

If

\(\text{\texttt{(if predicate \quad \text{expression-for-true} \quad \text{expression-for-false})}}\)

Example:
\(\text{\texttt{(if (even? x) (/ x 2) x)}}\)

If is a special form!

\text{e.g. special division}

Syracuse numbers

The Syracuse series is defined as follows:
When a number is even, half it
If it is odd, multiply by three and add one

Write a syracuse function

Study the behavior for various numbers

Difference procedure/process